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## ELECTRICAL CONNECTOR WITH DEFORMABLE INSERT

This invention relates to improvements in electrical connectors, in particular connectors for the mechanical connection or termination of one or more electrical conductors.

### BACKGROUND OF THE INVENTION

Electrical connectors comprising a tubular socket into which the end of an electrical conductor is inserted are widely used. Clamping bolts are commonly held in threaded bores in the wall of the socket and are used to fix the conductor to the internal surface of the socket, thereby establishing electrical and mechanical connection between the conductor and the connector.

A disadvantage of connectors of this type is that the internal dimensions of the socket (normally the diameter in the case of a socket of circular bore) are fixed. If the conductor inserted into the socket has a diameter substantially less than the internal diameter of the socket then the assembly of socket and conductor will be asymmetrical. This creates increased electrical stress when voltage is applied and can lead to difficulty in achieving effective insulation around the assembly.

It is known to utilise socket inserts or shims to make the effective internal dimensions of the socket more suitable for conductors of reduced diameter. However, known forms of socket insert suffer from the disadvantage that they may be difficult to position correctly, may be dislodged and lost prior to use, and/or may interfere with the clamping action of the bolts.

### SUMMARY OF THE INVENTION

There has now been devised an improved form of electrical connector which overcomes or substantially mitigates the above mentioned disadvantages.

According to the invention, an electrical connector comprises a connector body with a tubular socket to receive, in use, an electrical conductor, clamping means arranged to secure the electrical conductor within the socket, and a socket insert fitting within the socket so as to reduce the effective size of the socket, wherein the socket insert is tubular and is adapted to

be deformed by the clamping means into retaining engagement with the electrical conductor.

The connector according to the invention is advantageous primarily in that the socket insert reduces the effective diameter of the socket and hence reduces the eccentricity of the positioning of a small diameter conductor within the socket. This in turn improves the electric field properties of the completed joint and makes it easier to insulate. Apart from the provision of the socket insert, the connector may be of conventional design, enabling the socket insert to be used with readily available connectors. The deformability of the socket insert enables secure retention of the conductor within the connector. The socket insert is also relatively easy to manufacture and use.

10 The deformability of the socket insert requires that it be manufactured of a suitably deformable material. A preferred material is aluminium, especially 99.9% pure aluminium. The socket insert is conveniently formed by an extrusion process.

The deformability of the socket insert may be further enhanced if it is formed with a castellated or corrugated profile. A socket insert of such a form represents a further aspect of the invention, which thus provides a socket insert for an electrical connector having a socket in which, in use, an electrical conductor is received, the socket insert being tubular and deformable, and having a castellated or corrugated profile. In a further aspect, the invention provides an electrical connector including such a socket insert.

20 By a "corrugated" profile is meant a profile in which the material of the socket insert is of substantially uniform thickness but is formed into a succession of peaks and troughs. The peaks and troughs may have any suitable form, eg a saw-tooth type form or a wave-like form.

The term "castellated" means an arrangement in which the thickness of the wall of the insert is non-uniform, the wall of the socket being formed with a series of longitudinal ridges spaced, preferably equally spaced, around the socket insert. The regions between the ridges constitute regions of reduced thickness. The precise profile of the ridges and the intervening

regions may have any suitable form.

- A castellated profile is particularly preferred, as the ridges support the side of the socket insert remote from the clamping means when the socket insert is engaged by the clamping means, and this gives rise to more controlled deformation of the socket insert and hence more secure and efficient electrical connection between the conductor and the connector body.

The internal surface of the tubular socket insert may be provided with serrations or tooth-like formations to improve the grip of the socket insert on the electrical conductor and/or to improve the manner in which the socket insert is deformed in use.

The socket is most preferably a bore, most commonly a blind bore, of circular cross-section.

- The clamping means preferably comprises one or more clamping bolts held in threaded bores in the connector body such that they extend into the socket so as to clamp, via the socket insert, a connector inserted therein against the opposing surface of the socket. The bolts may have shearable heads which shear off when the applied torque exceeds a predetermined value.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- The invention will now be described in greater detail, by way of illustration only, with reference to the accompanying drawings, in which

Figure 1 is a perspective view of the end of a connector body forming part of an electrical connector according to the invention;

Figure 2 is an end view of a first embodiment of a socket insert for use with the connector body of Figure 1;

- Figure 3 is a cross-sectional view of an assembled connector comprising the connector body of Figure 1 and the socket insert of Figure 2, with an electrical conductor inserted into the socket insert but prior to securing of the conductor;

Figure 4 is a view similar to Figure 3, but after securing of the conductor within the connector; and

Figure 5 is a cross-sectional view of a second embodiment of a socket insert.

**DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**  
 Referring first to Figure 1, a connector body 10 is formed from aluminium and comprises a

5 tubular socket 12. The portion of the body 10 shown may be formed integrally with one or more similar parts incorporating further similar sockets, eg for end-to-end connection of two conductors. Alternatively, the body 10 may be formed integrally with a fixing flange for termination of the conductor.

10 A wall of the body 10 has a threaded bore 14 to receive a shear-head clamping bolt 15 (see Figures 3 and 4). The body 10 may be provided with more than one, eg two, such threaded bores 14.

15 A large diameter conductor may be inserted directly into the socket 12 and clamped using a bolt 15. For use with smaller diameter conductors, however, the socket insert 20 shown in Figure 2 is used. The insert 20 has the form of an extruded aluminium tube with a castellated profile. The internal bore 21 of the insert 20 is formed with a number of axial teeth 22 which enhance the engagement of the insert 20 with a conductor inserted into the bore 21.

20 The connector may be supplied with the insert 20 in position, in which case a simple resilient C-clip or the like (not shown), eg of plastics material, may be fitted into the open end of the socket 12 to prevent the insert 20 being dislodged prior to use.

In use, if a relatively large diameter conductor is to be clamped in the socket 12, the insert 20 is removed from the socket 12 and the conductor inserted. The clamping bolt(s) 15 are tightened until they clamp the conductor against the internal surface of the socket 12.

For a smaller diameter conductor 30 (see Figures 3 and 4), the insert 20 remains in position. The conductor 30 is inserted into the internal bore of the insert 20. The clamping bolt(s) 15 are then tightened until their tips engage and deform the insert 20. Continued tightening of the bolt(s) 15 securely clamps the conductor 30 within the socket 12, the head of each  
5 clamping bolt 15 shearing off when a predetermined torque is applied (as shown in Figure 4). The effect of the insert 20 is to displace the longitudinal axis of the conductor 30 closer to the centre line of the connector body 10 than would be the case if no insert were used. This improves the electric field properties of the completed connection and makes it easier to insulate. In addition, the same length of clamping bolt 15 can be used as for a larger  
10 diameter conductor.

The socket insert 40 shown in Figure 5 differs from that of Figure 2 in that it is of corrugated, rather than castellated, form.